Reading Horizons: A Journal of Literacy and Language Arts

Volume 3
Issue 2 *January 1963*

Article 4

1-1-1963

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DEVELOPING ELEMENTARY SCIENCE CONCEPTS BY AN INDIVIDUALIZED APPROACH

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In developing a concept of the universe at the elementary level many learning aids are utilized. Visual presentations, direct observations, experimentations and critical reading accompanied by discussions serve to enhance a child's understanding of a concept. Moreover, it is apparent that all elementary school children do not arrive at the same level of understanding of scientific phenomena. There are many children who do not respond effectively to experimentation and critical reading and thus must rely on direct observations and visual presentation in arriving at a lower level of conceptual development. Other children who are more sophisticated may understand the orderliness of scientific phenomena and display knowledge of the vastness and complexities of our universe. Branley (1), Sheckles (13), and Vinacke (14) have pointed out that differentiation and gradual progression take place in concept development as one matures. Further credence is given to this belief by Russell (12) who states that "concept development seems to move along a continuum from simple to complex, from concrete to abstract, from undifferentiated to differentiated, from discrete to organized, from egocentric to more social."

Since reading is one of the media by which a child obtains his mental impressions of scientific phenomena it permits him to identify, interpret and evaluate his experiences and put them into meaningful conceptual terms. His observations of the universe may be valid or faulty depending on the degree of accuracy of his perceptions. If a child's experiences in the area of reading are meaningless because of a low level of intellectual development, it is obvious that his conceptualization of scientific phenomena will also be meager.

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This paper is concerned with helping a third grade child, Randall, who had a reading disability, to develop meaningful concepts of the universe concurrently with the development of reading skills, to introduce the child to a scientific approach to problem solving, and to use science concepts as motivating factors according to the child's ability, interests and needs.

In assisting a child, the teacher must know his personal characteristics, general level of intellectual ability, home background and also understand underlying developmental trends and their causes. Persistent efforts on the part of the teacher should be made to adapt learning procedures to the needs, interests and abilities of the learner. Hence, an attempt was made to determine Randall's specific needs and to better understand his reading difficulties. Resource people include his parents, brother, previous classroom teachers, and a psychologist and social worker whom he saw weekly at the Child Guidance Clinic. Additional data were secured from the cumulative records. The staff at the Clinic cooperated with the writers in determining Randall's conflicts and frustrations especially in the area of reading.

Statement of Problem

Randall was an average, healthy boy who was unable to do satisfactory classroom work and, so it is reported, had become a disciplinary problem. His parents had asked, "Why is Randall retarded educationally and emotionally and why doesn't he want to succeed?" This problem presented a challenge to the senior writer, who was Randall's classroom teacher, so she gave him several psychological tests. From the results and the data secured from observations, interviews, and case history, an attempt was made to satisfy Randall's needs for successes while helping him to develop his basic reading skills.

Objective Data

	C.A.	*G.P.*	*M.A.*	*I.Q.*	*Percentile*
Chronological age—initial testing	8-5				
Grade Placement		3.4			
Stanford-Binet Test, Form L, Mental Age			8-4		
Intelligence Quotient				99	
California Personality Test, Primary Form A					
Personal Adjustment					30
Social Adjustment					35

	Grade	
	Initial	*Final*
Detroit Reading Test, Form I	2.2	3.2
Informal Inventory of Silent Reading		
Based on Gray Oral Reading Paragraphs	2.0	3.0
Elementary Arithmetic, Computation		
Stanford Achievement Tests, Primary	2.6	3.5
Spelling-California Achievement Tests	2.7	3.4
Morrison-McCall Spelling Scale	2.6	3.6
California Achievement Tests, Complete		
Battery—Grade expectancy	2.4	3.5

Home Conditions

Randall's father, who was in his mid-thirties, was a young patent attorney who had recently completed his law training. Neither parent had spent much time with Randall while his father was in law school. His mother had worked during the day and assisted her husband at night by typing his assignments. The father was reported to be the dominant member of the family. Both parents are well read, aggressive and conscientious workers. There is evidence of sibling rivalry between Randall and his older brother, aggravated by the latter's successes both academically and socially. Randall's brother, age 12 years, is a quiet, studious lad who is the "apple of his parent's eyes." It is reported that after his mother discontinued working, she attempted to compensate for her lack of attention by being over-attentive and over-protective toward Randall.

School History

Randall entered the first grade at the age of six years. He had not attended kindergarten or nursery school. He had been promoted each year at the request of his parents and not because of his academic and social attainments. He had attended three schools but there was little information available concerning his early development and growth. Randall was below average in all of his work. He enjoyed art and other activities that required manipulation with his hands, and yet he seemingly had poor coordination. He was a good swimmer and this success provided him some satisfaction. He was unable to get along with his peers and some of his teachers. He sought attention and

praise. It is reported that "to compensate for his inability to take part in classroom activities, he disturbed his classmates or annoyed his teacher." Although he had few friends, he tried to help the younger children or those he considered to be the "underdogs." He lacked self confidence and his self concept was poor. In his art work he displayed talent and interest but rarely finished a project because he was a perfectionist and could not meet the standards he had set for himself. He reacted negatively by ignoring any instructions or assignments which were given to him. His reaction to his parent's constant prodding was that of negativism.

Randall, who was a true sinistral, i.e. left-handed, left-footed, and left-eyed, became frustrated when his parents forced him to use his right hand during the beginning phase of learning cursive writing. He had been able to print with his left hand fairly well, however, his cursive writing was illegible. The conflict between the use of his right or left hand was resolved when his parents permitted him to use his left hand when he so desired. There was a noticeable improvement both in his writing and printing and his general attitude toward life.

Individualized Instruction

In an attempt to motivate Randall and to develop self reliance, individualized instruction was provided for him. Following the general plan used with his classmates, a practical approach was followed in appraising and developing concepts through a sharing of pupil and teacher experiences by informal but directed discussions. After several periods of discussion, Randall became interested in the general topics of the "earth and the sun," "Why we have day and night," "Why is a day twenty-four hours long?" "What causes summer and winter?" "What is a satellite?" "Is it possible to live on the moon?" "Man-made moons are satellites." "When will we put a man on the moon?" These concepts and questions were constructed from his past experiences and from knowledge acquired from his peers. They now became more meaningful to him following these discussion periods. His previous visit to a planetarium in the East, his evenings spent looking at the stars while camping near Lake Michigan, and a night hike to study the sky while at a Boys' Camp resulted in meaningful experiences for Randall. From these activities a compilation was made of the concepts he had acquired and a tentative plan of study was prepared by the teacher. Included in this plan were various introductions to available

content matter at his reading level, simple experiments, suggestions for correlation with the language arts, music and art, and lists of poems, filmstrips, books and audio-visual aids that were available. All these plans were general and subject to change.

Randall, starting with his own experiences and familiar situations, expressed his own ideas freely—some were authentic and others were copied. With assistance from his teacher and by means of experimentation and observation, many of the incorrect and partially developed concepts were clarified or eliminated. Learning occurred when Randall recognized the problems that confronted him in his experimentation and tried to solve them. The development of meaning in science is considered as interpretations of natural phenomena in our universe and is useful and applicable to other situations in life. As concepts became less concrete, they became more abstract, that is, they lost "the thing-character that ordinary objects possess and became generalizations." (8:321) To help children generalize (12) they must have a number of examples to study for their common characteristics. Naming the parts of an object requires more thorough observation than a child might ordinarily give, so probing for meaning was necessary and this was done by further questioning Randall's interpretations. In expressing himself, whether correctly or incorrectly, he gained some benefit from these experiences, since growth is not always measured in terms of correct answers but rather through rational choices.

The questions and statements that Randall formulated not only reflected his experiences and mental content on which the teacher helped him build more complex concepts, but they also assisted the latter to formulate future instructional plans. The discussion sessions with Randall centered around his interest in finding solutions for the questions he raised about scientific phenomena. In a study of children's contributions to scientific discussions, Hill (9) found that young children are capable of questioning, identifying, speculating, recognizing relationships and drawing conclusions, so opportunities should be provided children for utilizing these abilities as well as encouraging them to do critical thinking. Films, filmstrips, collections of pictures by Randall and his classmates, and other audio-visual aids were introduced as the proper opportunity and need presented themselves. Although understanding can best be built on actual experiences, audio-visual aids were very helpful in clarifying meanings for Randall.

Since Randall had initially avoided books, the *experience chart*

was introduced to help him organize his ideas, use information that he had acquired, integrate the language arts, think critically and to foster a desire to seek further information about the sun, moon, stars, earth, and planets. The chart provided an informal introduction to silent and oral reading that was motivated by Randall's own experiences.

A trip to the local museum and planetarium was planned and Randall was encouraged to observe and compare this planetarium with the one he had visited in the East. Later an attempt was made to integrate authentic material with Randall's observations. In preparation for this trip, Randall and his classmates formulated and listed on the chalkboard, many questions about things they wanted to know more. A letter was written to the director of the museum by Randall asking permission to visit at a particular time. Randall used his newly acquired skill in cursive writing to good advantage and it provided him another meaningful experience in which to enhance his scientific interest in the universe. While at the museum, his teacher took the opportunity to show Randall the Children's Room with the many interesting books housed within. Without being unduly influenced, he selected a volume of the *Singer Science Adventures Series,* grade two (7), and took it home to read. He seemingly experienced satisfaction and pleasure in reporting his findings to his parents and classmates.

Simple experiments and activities, approached in a scientific manner, were introduced and from these meager beginnings more complex principles were developed. Under the guidance of the teacher, Randall learned to differentiate between *inferences and observations* and wrote short reports of his experiments. Many new words were introduced and added to his vocabulary. To facilitate this vocabulary growth and to capitalize on his interest in art and his success in writing, *a picture dictionary* was started with each word written on a 3″ by 5″ filing card and housed in a card file. He either found a picture or drew one to illustrate the meaning of the word and he wrote a definition of it in his own vernacular. This motivated him to further study. Randall was delighted when he found words with two meanings and it provided him with an incentive for further word study. The picture dictionary grew rapidly and from this beginning he was gradually led into the use of regular dictionaries.

The need for directed study of the spelling and use of words soon became evident. Hence, Randall was introduced to the visual, auditory,

kinesthetic and tactual method of unravelling difficult words. This approach known as V A K T includes the following steps. (4)

Look at the word, its beginning and its ending.
Say it aloud.
Spell it aloud.
Trace the word with index finger.
Write it.
Compare it with word studied.
Repeat process until mastery is acquired.

Other word study skills were introduced as opportunities were presented, such as: word recognition by contextual clues, picture clues, language-rhythm clues, and configurational clues, structural analysis and phonetic analysis. In the latter, a direct approach was necessary to undo the teaching done by his father who had taught phonics in such a way that Randall had no interest in word meaning.

Randall's stock of sight words did not include the 220 basic sight words as given in the Dolch word list (6), so a short daily drill, not more than five minutes, was given to him. This drill not only aided Randall in the recognition of words, their spelling and pronunciation, but also emphasized the meaningful use of words in sentences, experiments, discussions and reports.

As Randall became more interested in books, he visited his school library with his teacher and a small group of his classmates. There, he found many interesting books at his own reading level and selected books which could provide answers to his problems in various science areas. At this time Randall began to read for a purpose. He read to answer questions that were either self-made or provided by the teacher. Skill in locating information was introduced as opportunities arose and his capabilities and interests allowed. For the most part science books were used when Randall and the teacher were studying together since they served as resources for building concepts from the simple to the more complex.

The development of meaningful science concepts is a goal for which all elementary teachers should strive to achieve, and the criterion of success is the extent to which the child can use meaningfully what he learns. The teacher must identify the elements that are to be transferred but the amount of transfer depends, to a large extent, on the pupil's general ability, interests, and motivation. Children learn

and retain the things that are of concern to them and which they regard as important. (10)

A continuous evaluation was made of Randall's progress and notations were made regarding his mental, physical, psychological and environmental adjustment. Other evaluation aids included: teacher-made tests, cross word puzzles developed by Randall, fill-in, matching, and true and false tests, story problems using facts needed by Randall to understand a science concept, and a one-page newspaper edited and mimeographed with the assistance of his teacher and classmates.

Experience charts, picture dictionary cards, oral discussions, written reports and other integrated tasks helped the teacher to evaluate Randall's learning and proved to be strong motivating factors in the development of Randall's feeling of success which was reflected in his self confidence and his ability to attack new problems.

It is the opinion of the psychologist and social worker at the Child Guidance Clinic that Randall has made satisfactory emotional and academic progress and with continued motivation and successes, concurrent with improvement in reading skills, he should develop independently in all areas of growth.

Conclusions and Summary

In developing a concept of the universe concurrently with reading skills, a teacher should:

Capitalize on the child's interests.

Plan with the child and formulate definite instructional outlines.

Build new concepts on previous experiences and proceed from the concrete to the abstract.

Help the child to find answers to questions.

Provide opportunities to observe, investigate and experiment.

Help the child to identify, interpret and evaluate his concepts and problems.

Use first hand experiences and materials but recognize and use audio-visual aids.

Help the child to develop a scientific approach to problem solving.

Teach reading meaningfully and effectively.

Understand the child, his pattern of development, his interests, ambitions and needs.

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